VOLUME XXII NUMBERS 1 WHOLE NUMBER 170

THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

EDITOR
C. A. CHANT
University of Toronto, Toronto

ASSOCIATE EDITORS
J. S. PLASKETT
Director of the Dominion Astrophysical Observatory, Victoria, B.C.
SIR FREDERIC STUPART
Director of the Meteorological Service of Canada, Toronto
R. MELDRUM STEWART
Director of the Dominion Observatory, Ottawa

PUBLISHED MONTHLY
(*Ten numbers per year*)

January, 1928

PRINTED FOR THE SOCIETY
TORONTO: 198 COLLEGE ST.

FOREIGN AGENTS: WHELDON & WESLEY LTD.
2-4 ARTHUR STREET, NEW OXFORD STREET, LONDON, W.C. 2

THE JOURNAL

OF THE

ROYAL ASTRONOMICAL SOCIETY OF CANADA

Vol. XXII, No. 1 | January, 1928 | Whole No. 170

Articles PAGE

The Pons-Winnecke Comet ..... *R. M. Motherwell* 1
John Brashear, the Beloved ..... *W. J. Holland* 3
Astronomical Site Testing in Samoa ..... *R. C. Hayes* 7
A Plea for a Better Knowledge of the Stars ..... *A. W. Megget* 9
Uses of Calculating Machines in Astronomical Calculation ..... *C. C. Smith* 17
The Planet Neptune ..... *W. G. Colgrove* 20

Review of Publications

Isostasy (William Bowie) ..... *C. A. C.* 23
Space Distribution of the Stars of Different Types in the Cygnus Region (Maxwell) ..... *W. E. H.* 23
Anual Report of the Director, U. S. Coast and Geodetic Survey, *C. A. C.* 25

Notes and Queries

A Personal Note (H. H. Plaskett)—A New Fellowship at Harvard—The Aurora, its Height and Audibility—Audibility of the Aurora (C. C. Davidson)—A Remarkable Meteorite (Siberia)—A Large Disc of Glass—When did the Moon Rise? *C. A. C.* 27

Meetings of the Society

At Toronto (E. J. A. Kennedy) 31

Upon request, made previous to publication of article, contributors will be supplied free either with fifty copies of the issue containing the article, or with the sheets containing the article stitched in a printed cover. If separate reprints are desired the cost will be as follows:

	4 pp.	8 pp.	12 pp.	16 pp.	20 pp.	24 pp.
50 copies	$3 50	$6 50	$ 9 50	$10 00	$13 00	$16 00
100 copies	4 00	7 00	10 00	11 00	14 00	18 00
200 copies	4 50	8 00	11 00	12 00	15 50	20 00

Covers, extra, 50 copies, $1.50; 100 copies, $2.00; 200 copies, $2.50.

Business correspondence, remittances, etc., should be addressed to H. W. Barker, Treasurer of the Society, 198 College Street, Toronto.

Communications regarding Library matters should be addressed to the Librarian.

$2.00 per annum. Single numbers, 25 cents.

Subscription to the JOURNAL is included in membership fee.

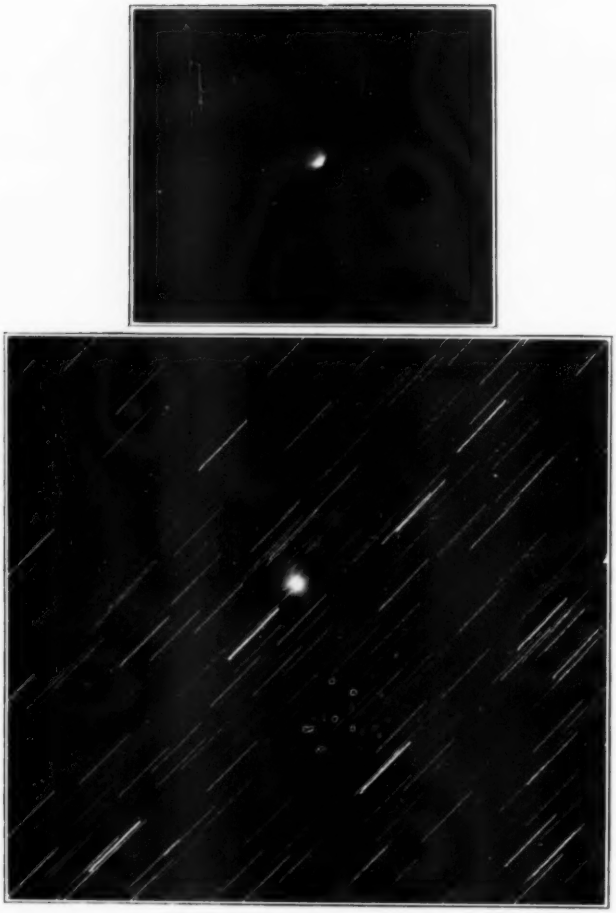
FOR SALE

Telescope, 3-inch "Century" by Watson, London, Eng.; 2 celestial, 1 terrestrial, eyepieces. In box, with mahogany tripod. Enquire W. G. McMillan, 64 Howland Ave., Toronto. Trinity 2283.

Telescope, 8½-inch reflector. Mirror by Linscott (English maker). Price $75. Enquire H. C. B. Forsyth, Leeson-Lineham Block, Calgary, Alta.

Transit Instrument, by Troughton and Simms, aperture 1¼ inches. Enquire A. L. Waddell, 199 Avenue Road, Toronto.

PLATE I



THE PONS-WINNECKE COMET

Above:—Photograph by D. B. Marsh, Parry Sound, Ont., with a negative amplifying lens on a 5-inch refractor, June 26, 1927, 1.30 a.m. Exposure 30 minutes.
Below:—Photograph by R. M. Motherwell with 8-inch camera, June 23, 1927. Exposure 2 hours. (Top is North)

Inscription on Statue:—

John Alfred Brashear
1840-1920
Founder of the
New Allegheny Observatory
Presented to the
University of Pittsburgh
by Loyal Friends
Dedicated Novmeber 1927

THE JOURNAL
OF THE
ROYAL ASTRONOMICAL SOCIETY
OF CANADA

VOL. XXI, No. 1 JANUARY, 1928 Whole No. 170

THE PONS-WINNECKE COMET

By R. M. MOTHERWELL

THIS comet was discovered on June 12, 1819, at Marseilles, by Pons, who had the remarkable record of twenty-seven comets discovered between 1803 and 1827. Encke computed its orbit and announced that it was periodic, with a period of about five and one-half years. It was not seen again until March 8, 1858 when Winnecke observed it at Bonn. He thought at first it was a new comet, but a study of its orbit soon revealed its identity with the Pons comet of 1819 and hence comes the name Pons-Winnecke. On its return in 1863 it was not observed, being unfavourably placed for observation, but in 1869 it was again discovered by Winnecke, who described it then as a faint object about six or eight minutes of arc in diameter. It has been observed several times since, the return in 1886 being unusually interesting as its perihelion passage was twelve days ahead of schedule. Oppolzer considered that this acceleration could not be accounted for by the theory of gravitation alone but that there must be some resisting medium.

It was due at perihelion on June 21, 1927, and was discovered by Van Biesbroeck at Yerkes Observatory on February 27. It was afterwards located on plates taken at the Greenwich Observatory on February 25. Photographs were taken at the Dominion Observatory on every possible occasion during June and July until it was too far south. At the beginning of June it was too faint to permit of accurate guiding with a 5-inch telescope, but by June 21

it was visible to the naked eye. An exposure of two hours on June 23 with an 8-inch doublet showed a diffuse nebulous head with a rather sharp nucleus and a faint suspicion of a tail not over one half a degree in length. When observed with the naked eye the comet had the appearance of a very faint nebula or hazy patch in the sky.

Although this comet is seldom visible to the naked eye it never gets beyond the solar system. When at aphelion it is slightly over five hundred million miles from the sun and at perihelion it is about one hundred million miles from the sun. As the plane of the comet's orbit cuts the plane of the ecliptic at an angle of only 19° the comet and the earth remain close together for a considerable period if they arrive at the critical points in their orbits at the same time. That condition occurred on June 27, 1927, six days after the comet reached perihelion. The distance between the two bodies was about three million miles and the announcement of this close approach was the cause of such unusual interest on the part of the public. While three million miles is a short distance astronomically speaking, this event was not unique, as in 1770 Lexell's comet came within one and one half million miles of the earth. Even at that distance, however, there was no sensible change in our orbit.

At no time in its past history, as far as known, has this comet been anything but an inconspicuous member of the solar system. There never was any tail or any marked sign of increased activity in the head as it passed perihelion, so there was no reason to expect a brilliant object last year. To those expecting a dazzling object with an immense tail stretching across the heavens it was a disappointment, but not to those familiar with its history. It appeared on scheduled time and behaved just as any ordinary comet should. It has never been anything but a diffuse nebulous object with a small central nucleus and it is a safe prediction that in the centuries to come it will be a faint object varying in brightness as it is close to or far from the Earth.

Dominion Observatory,
Ottawa, Dec. 19, 1927.

JOHN BRASHEAR, THE BELOVED

By W. J. Holland

An address delivered November 24, 1927, at the Allegheny Observatory on the occasion of the Presentation and Unveiling of the statue of Dr. John Alfred Brashear.*

WE gather this morning to honour the memory of a man whom many of us intimately knew, one of whose foremost traits was his ability to win the applause and love of his fellowmen. This he accomplished to a degree rarely achieved by any man in private life. He came to be known as the "most beloved citizen of Pittsburgh." For some years before his death he was fondly called "Uncle John," and enjoyed being thus addressed. He was more or less ubiquitous and ever ready to amuse a small company or a great audience with a droll story, or by an entertaining and instructive discourse. He was at all times accessible, kind and sympathetic, whether his visitor was a tramp or the president of a university. The list of his acquaintances was legion, and he greeted them all with a smile. His repertoire of knowledge was chiefly found in his shop, or in the heavens. The sun, the moon, the comets, the stars, light, heat, and diffraction-gratings were the staple of his discourse. The whole world is interested in celestial phenomena, and when "Uncle John" spoke in his familiar way about the stars, now and then in-

*The program of the occasion was: (1) *Address of Welcome,* by Benjamin Thaw, Chairman of the Observatory Committee, University of Pittsburgh; *John Brashear, the Beloved,* by Dr. W. J. Holland, Ex-Chancellor of the University, President of the Carnegie Hero Fund; *Presentation of the Statue to the Committee,* by Frank Vittor, Sculptor; *Unveiling of the Statue and Presentation to the University of Pittsburgh,* by Mme. Felicie de Croisier Winn, Chairman of the John Brashear Statue Fund; *Acceptance of the Statue on behalf of the University of Pittsburgh,* Dr. S. B. McCormick, Chancellor Emeritus of the University. The Statue Fund Committee consisted of Mme. Felicie de Croisier Winn, Mrs. W. H. Stevenson, Mr. Sidney A. Teller. The statue is of life size (See Plate II), and the unveiling took place on the 87th anniversary of Brashear's birth.

terpolating a mirth-provoking tale, he was always greeted with applause, which warmed his heart. In the end he almost became a popular idol. When he died, his remains lay in state in the great hall of the Soldiers and Sailors Monument, and honours such as are only accorded to kings and presidents were paid to him. The present gathering is an echo of what occurred when he passed away. We are present to add our tribute to the memory of the kindest and most entertaining men of his day and generation.

I knew John A. Brashear from the very first day on which I made my appearance in Pittsburgh. When I was a child, living in a village in Ohio, the village physician was Dr. Bela B. Brashear. He was a member of the church of which my father was the pastor. He later became a surgeon in the Army of the Southwest and went with Sherman "from Atlanta to the sea". On the morning on which I preached my first sermon in Pittsburgh, a tall soldierly man was in the audience, and when I stepped down from the pulpit he came up to me, and, laying his hand on my shoulder, asked me whether I remembered a certain occasion when, as he said, "I saved your life." It flashed upon me that he was the physician who had stood by my bedside when I was a little child, and I recognized him as Dr. Brashear. His grandson is Thornton Oakley, the artist and illustrator. Turning to a man who was standing beside him on that morning he said to me, "this is my cousin John. He came with me to hear you preach." John was at that time a millwright, and from that time to the day of his death I was constantly in contact with him in the work of the Iron City Microscopical Society, of which I was long a member and its President; in the Academy of Science and Art, of which I was the first President, and in which he succeeded me as President; in the Board of Trustees of the University; and of the Carnegie Institute; in many enterprises looking toward the educational development and the general uplift of the community. I do not think that any man in the circle of his whole acquaintance had better opportunity to understand him thoroughly and to appreciate more justly his many excellent traits.

John A. Brashear did more than simply to endear himself to the community in which he lived. He was a man of achievement. In the face of difficulties, which would have staggered many a man,

he slowly and surely won his way upward as a craftsman, until he came to be recognized as one of the most skillful makers of instruments of precision in the United States, if not in the world. Supported by the wise counsel and the financial assistance of that princely man, the late William Thaw, he began the manufacture of optical surfaces and telescopic lenses on a large scale, and from his laboratory on the hilltop, not far from us, there went forth many of the finest pieces of work of that kind, which ever had been made by the hands of man, and which are accounted to be not merely the chief ornaments, but the most useful possessions, of many of the great observatories of the world. The lenses in the great refracting telescope in this famous observatory were made by him, as well as much of the other apparatus assembled under these domes.

When in the early spring of the year 1898 Professor James E. Keeler, Director of the Allegheny Observatory informed me as Chancellor of the University, that he had been elected to the Directorship of the Lick Observatory, but that he would decline to accept the position tendered to him, if he could be assured that immediate steps would be made to place at his command a new observatory with proper equipment in Allegheny, Uncle John came to me and informed me that he believed that he could at once raise the money required for this purpose. I already had secured the promise of substantial assistance in one or two quarters; but, having just completed a successful effort to secure an endowment of $100,000 for the Western Pennsylvania School of Mines, I was a little tired of soliciting funds, and not at all reluctant to turn over to my friend, Brashear, the task which he seemed so very eager to undertake. He went at it with a will. The goal set, if I remember correctly, was $150,000. Mr. Brashear made splendid progress, but did not quite reach the goal in the time allotted for the undertaking, and Mr. Keeler left us. But Uncle John from that time forward continued valiant efforts, which at last were crowned with success, and this great observatory, as it stands to-day upon this eminence, which it adorns, is the fruit of his endeavour. It is most fitting that within these walls, which are the mute memorials of his patient and persistent efforts, the statue, which is to-day to be unveiled, should be placed. The names of many great men, famous for astronomical

discoveries and discoveries in the domain of physics, link themselves with that of the Allegheny Observatory, but not the least of these names is that of John Alfred Brashear.

Uncle John did many other things in a helpful way in this community, which he loved, and which loved him. He took an active part as a Trustee in the affairs of the Carnegie Institute, serving on various committees and helping to shape policies. He was chosen by Mr. H. C. Frick as the head of the Board of Trustees of the Educational Fund, created by that secretive donor of good gifts to the people, in which position he remained from the beginning until the day of his death.

Through the kindness of friends he was able thrice to visit Europe and once to repair to Japan, China, and the Philippines. Of the experiences which he had on these journeys, as well as through his long journey through life, he has recorded his impressions in his *Autobiography* recently published, a most entertaining book, which I commend to the attention of any of those present, who may not have read it.

Measured by popular standards John A. Brashear was altogether remarkable. Without early opportunities, by dint of industry, by unwearying effort, aided by friends who put at his disposal their brains and their purses, he achieved a reputation, which was far wider than the community in which he lived, and accomplished many things, which will cause his name to be long remembered.

His ashes and those of his beloved wife and of his friend and teacher, Professor Keeler, rest beneath the dome of this observatory. Peace and honour to their ashes, and to those of all good men, their friends and associates, who, with their feet planted on the earth, looked forth to the stars, and are now, as we trust, at home with that Father of us all, "in whose house are many mansions."

ASTRONOMICAL SITE TESTING IN SAMOA

A Preliminary Note on the Suitability of a Tropical Island for an Astronomical Observatory.

By R. C. Hayes

DURING the months of August and September, 1926, the writer carried on a series of astronomical observations for the purpose of testing the atmospheric conditions in the tropics. The observations were made at Apia, on the northern shore of the island of Upolu (lat. 13° 48′ S.; long. 171° 46′ W.); and the instrument used was a small refractor of two inches aperture with a magnifying power of 80. Although a larger telescope is desirable for this work, previous experience in New Zealand showed that, if carefully handled, a small instrument gave quite good results. The scale of seeing given below was that used by observers in New Zealand, and published in the New Zealand Astronomical Society's Notes for October, 1923:—

0.—Star disc and diffraction rings confused and enlarged.
2.—Disc and rings confused, but not enlarged.
4.—Disc defined; no evidence of rings.
6.—Disc defined; rings broken, but traceable.
8.—Disc defined; rings complete, but moving.
10.—Disc defined; rings motionless.

On this scale, 0 indicates very bad seeing, and 10 excellent seeing.

The period of observation was short; but as conditions in Samoa do not vary much from day to day, the results obtained were sufficient to show that the seeing is decidedly better than might be expected in a warm, moist climate. The percentage of observations falling under different numbers on the scale of seeing was as follows:—

4.—13 per cent.; 6.—54 per cent.; 8.— 33 per cent.

These figures show that the average conditions would be somewhat greater than 6, which might be classed as "fairly good seeing." It will be seen also that the range of observations was not great; no observations being obtained below 4, or above 8. The thermometer was always read at the time of observing, and a definite correlation was found between the seeing conditions and the temperature. Contrary to what might be expected, the seeing was good on a warm night, but was found to be decidedly poor on a cool night.

The night temperature at Apia is governed mainly by the direction of the wind. If the wind is blowing on-shore, the night will be warm, and, if clear, the atmosphere will be surprisingly steady. On most clear nights, however, cool air flows down from the hills towards the sea, where it mixes with the warm air over the ocean, producing a most disturbed atmosphere. This land breeze is sometimes so cool that a slight fog is formed along the coast in the early morning. Of course, this disturbing temperature effect would not occur in the interior of a continent, but even there we find another serious drawback to astronomical work—and that is the unequal distribution of cloudy weather throughout the year. In tropical countries by far the greater portion of the annual rainfall occurs in the summer months. In Samoa the wet season is from November to May; and cloudy weather is so persistent in the months of December, January and February, that astronomical work would be seriously hampered at this time of the year.

Observatory,
Apia, Samoa.

A PLEA FOR A BETTER KNOWLEDGE OF THE STARS*

By A. W. Megget

VERY few people have any idea of the immense depths of space and how far distant is even the nearest star. You would imagine that we who have to live for many years on this planet called "The Earth", would like to have some notion as to what kind of world it is—where it comes from, where it is going in space, what keeps it in its place year after year and century after century, what causes day and night, how fast we are moving through space and in what direction we are going; how far off are the stars, what they are made of and at what speed they are travelling; and of many other similar questions which arise. To all of them Astronomy has a sure and definite answer.

Yes, there are many who may well send up Carlyle's oft and repeated plaint, "Why did not some one teach me the constellations and make me at home in the starry heavens which are always overhead and which I do not half know."

When the sun has set and the earth is dark and the beauty it had in the daytime has vanished, the heavens call us to look upwards and they open to us a wonderful spectacle. On a clear, moonless night, the stars appear uncountable and seem to cover the sky from the zenith—the highest point overhead—down to the horizon. If you were asked to guess how many stars you could see with the unaided eye, you would, perhaps say, "Millions", but you would be wrong, for the number of stars visible to the naked eye, in the whole heavens, is about 5,000 and at any time less than half of this can be observed.

Despite the apparent richness of the sky, the emptiness of space

*A paper given at the monthly meeting of the Winnipeg centre on April 13, 1927.

is its most striking characteristic. In fact the Stellar Universe is almost totally telescopic.

There are 21 first magnitude stars, the brightest of which is Sirius. This star is 26 times as luminous as our sun*, and is also the nearest star visible to the naked eye is this hemisphere. Yet light, which travels at the speed of 186,000 miles a second, takes 8½ years to reach us from this star. That is, if Sirius disappeared to-day, we should still see it for 8½ years. Each descending stellar magnitude has about 3 times as many stars as the previous one. A sixth magnitude star has a hundredth part the apparent brightness of a first magnitude star.

The unaided eye can distinguish stars down to the sixth magnitude, the largest telescope down to about the 19th; and stars down to the 21st magnitude can be photographed with our largest telescope, and we know that more powerful telescopes will show us more stars. The universe holds billions of stars too far off or too small to be recorded by our present instruments, so that it might be supposed the universe was unending. In reality, this is not so, for if the whole sky were one mass of stars, as it would be if their number were infinite, then, although we could not distinguish the separate stars, we should see it bright with a diffused light. This is not so, and we judge the universe as not unending, though with all our inventions we may never be able to probe to the end of it. Our little solar system is set by itself like a little island in space and far, far away on all sides are other great light-giving suns more or less resembling our own, but appearing as tiny points of light by reason of the great void of space lying between us and them. Of all these billions of stars,—each one a sun—some we know having a density 50,000 times that of water, some a thousand times less dense than our atmosphere, and many of them most likely surrounded by a family of planets like our sun.

Can it be that in all these billions of worlds, our earth is the only world fit to sustain life and intelligence? Nature never works in singles. The same conditions as found on the earth will be found elsewhere, with many variations. Nearly every metal, gas and sub-

*See "Astronomy" by Russell, Dugan and Stewart, p. 637.

stance that we know of, by means of spectroscope, can be shown to exist in our own sun and in every sun in the entire universe.

Helium gas was first found in the sun before it was recognized upon the earth. It is a non-inflammable gas almost as light as hydrogen gas, and is therefore used for balloons. Before the war it cost $2,000.00 a cubic foot, but at the close of the war, could be made at a cost of about 10 cents a cubic foot.

Where can you find a subject more full of romance than the heavens above us, in which the imagination can roam at will in the fairyland, as it were, of science?

A few minutes' study each clear night for a few months, will make you familiar with the principal constellations, and you would soon be on friendly terms with many stars. Anyone who will take the trouble to give the stars a little study, will never regret it. They have a fascination all their own, and are spread above us as one of nature's grandest picture shows, to which the admission is free to all, and what romance and mysteries they hold? All they ask is a little study to unlock many of their wonders.

A poet can often, in a few words, portray a more striking picture than a scientist can do in many pages. When looking at the stars, the two beautiful lines from Longfellow's Evangeline often come to my mind:

> "Silently one by one in the infinite meadows of heaven,
> Blossom the lovely stars, the forget-me-nots of the angels."

These two lines draw a striking picture of what we see every clear night. But, alas, how few of us give the heavens above us the attention which is their due, unless, perhaps, to turn over our money when we see the new moon, face to face; or study the clouds to see what sort of day we are to expect.

What would you think of a man who went to a picture show and shut his eyes all through it? You would think him rather queer. Yet, what picture show can compare with the wonders of even our solar system? Who has not felt a thrill when seeing for a first time the beautiful planet Saturn and its mysterious rings, or the giant planet Jupiter, a planet 1300 times the size of our earth, and watching its four moons as seen through a small telescope—playing hide and seek with the planet? Writing of the stars, Ralph Waldo

Emerson says: "One might think the atmosphere was made transparent to give man in the heavenly bodies, the perpetual presence of the Sublime." If the stars should appear one night in a thousand years, how would man believe and adore and preserve for many generations the remembrance of the City of God, which had been shown.

"One sun by day—by night ten thousand shine
And light us deep into the Deity."

Yet, it is truly said that the shepherds watching their flocks on the Plains of Chaldea 5000 years ago, were more versed in their knowledge of the stars than the dwellers in our modern cities, where the hurry and rush of business and pleasure and the glare of the electric light prevent them giving the heavens the attention which is their due.

Kelvin McKready says: "And if there be 'no time' in our busy generation for a sense of the mystery of the stars, is not this one of the reasons why we should take time for them, and for the healing power of those silences to which they league their unceasing invitations? Our life, just now, is not too rich in imagination—nor too deeply moved by the sense of reverence or the touch of wonder."

We read of the splendour and mystery of the heavens, and how the mind of man is reaching out farther and farther into the infinities of space, and is able to measure the distance of stars trillions of miles away, to weigh them, tell the speed at which they are rushing through the space, and in what direction, their density and diameter and through the analysis of their light—which in some cases started out on its long journey before the Pyramids were built,—is able to tell us what chemical elements they are constructed of.

We know that our sun is a slow mover compared with many of the stars, but even it is moving in a certain direction at the modest speed of 12 miles per second, dragging its retinue of planets and their satellites along with it. Every day that we live finds us a million miles nearer to the beautiful blue star Vega, in the constellation Lyra, and we are told we shall reach where Vega is now in about 200,000 years, but when we get there Vega may be as far off as ever, for it is also rushing swiftly through space. Modern man has invented instruments that will measure an angle 1/360 the diameter of a

human hair, can measure the heat of a candle two miles away, can even tell us the heat of different localities on the planet Mars, can photograph objects which cannot by seen by the human eye, is able to resolve the Milky Way into myriads of stars—each star a sun, some like ours, some quite different in their composition. Yes, modern man with his wonderful inventions can pierce through our sidereal system, which we are told measures 300,000 light years across, and study the universes of stars in outer space, passing our system like strange ships in the night.

Light travels from the moon to the earth in 1¼ seconds, from the sun in 8½ minutes, crosses the solar system, a distance of over 5000 million miles in eight hours, yet takes 4.3 years to reach us from the nearest star. There is no star less than 275,000 times the sun's distance. The nearest star Alpha Centauri is 25 million million miles away. Now one million seconds make 11½ days, but one million million make 30,000 years. There are only two stars within a distance of 500,000 times the sun's distance from the earth. Such is the emptiness of space. The light which reaches us from many stars left them hundreds of years ago, and could it tell what was happening on some of the stars as it left them, you would be the witness of events which happened before Columbus discovered America.

It is frequently necessary for an artist to put a man or animal, whose size is familiar, into a picture, in order to enable us to appreciate the size of other objects. In like manner, we are better enabled to grasp stupendous magnitudes by drawing comparisons between magnitudes which we can easily comprehend. If we were to represent the distance between the earth and the sun on such a small scale as a yard stick, three feet long, a small marble one-third of an inch in diameter would represent the sun. The earth would be represented by a small speck one-three hundredths of an inch in diameter, just visible to the naked eye, at a distance of three feet. Neptune, the outermost planet, would be represented by a small speck at a distance of ninety-eight feet. This would represent our solar system in miniature, and if we wished to represent the distance to the nearest star on the same scale, the double sun Alpha Centauri would be represented by two small marbles placed more

than 170 miles away, while the next nearest star, the double sun 61 Cygni would be represented by two small marbles more than 300 miles away. Imagine two tennis balls, one placed in Vancouver and the other in Quebec, and moving one mile each century. This would fairly well represent the distance of our sun from the nearest star, and their small chance of ever meeting one another.

I shall now speak of some of the coloured stars. We indeed live in the midst of a jewelled universe. Our gardens have their beautiful flowers of every colour. The stars—the flowers of the sky—are also of many colours. Arcturus and Capella are golden coloured, like our sun; the beautiful star Vega shines like an arc light on the sky; Sirius and Spica are a bluish white; Rigel—a hugh star in the constellation of Orion and distant 500 light years—is steely white; Mizar—the larger of the two stars at the bend of the handle of the Dipper—is a telescopic double and seen through a small telescope, sparkles like two beautiful diamonds. Arcturus gleams like gold. Aldebaran, Betelgeuse and Antares are of a dull red colour and there are other stars of every hue. Many of the binary stars are of different colours, like that favourite for a small telescope, the star Albireo, at the foot of the Northern Cross, which is composed of two stars, one orange coloured and the other blue. When looking at this star, one wonders what conditions would pertain on an imaginery planet warmed by two such suns as these. Part of the day it would be illuminated by an orange coloured sun and part of the day by a blue coloured sun.

Then let us turn to the huge star clusters, where stars are apparently crowded together in countless thousands. The globular cluster in Hercules, which Shapley tells us is 36,000 light years away, consists of about 50,000 suns, many of them much larger than our sun, but so far off that, to the unaided eye, this cluster looks like a hazy patch of cloud the size of the palm of one's hand. There is a fine double cluster in Perseus. There are many clusters in Sagittarius. There are also many open clusters, such as the Pleiades, and the Hyades, both in the constellation Taurus, and Praesepe, the beautiful cluster in Cancer; Coma Berenices and many others.

Then the heavens have thousands of nebulae. There is one in

the constellation Orion. In a small telescope it looks like a cloud of green mist. It shines by its own light and the spectroscope shows that it consists principally of hydrogen and helium and an unknown gas which has been called nebulium.

How quiet this huge object appears to be, yet we are told it is a seething mass of gas, where there is no rest and over whose vast bulk motions of several miles per second are constantly taking place. Yet so far off is this nebula that its light has taken nearly 1000 years to reach us.

Let us now turn to the spiral nebulae. There is one in the constellation Andromeda, which astronomers tell us is one million light years distant, and is another universe of stars, external to our stellar universe, and the beam of light which brings this object to our telescopes, started on its journey long before man appeared on this planet earth.

The study of the stars should interest everybody, for our sun is a star and what happens to a star, may happen to our sun. Every few years a new star suddenly blazes up, sometimes even to outshine the bright planet Jupiter. Some have even been so bright as to be visible in broad daylight. Then, in a few weeks, they may diminish in brightness and finally disappear. These temporary stars, or novae, may be due to dark bodies on their journey through space encountering a nebula, of which there are thousands in the universe. There was a nova in 1901, in the constellation Perseus, which in a few days increased in luminosity over 40,000 times. Now, as I have said before, what happens to another sun may some day happen to our sun. But we need not worry, for astronomers would foretell many years in advance the approach of a star which might cause any disturbance to our solar system—and give us plenty of warning.

Sunspots which we read so much about, especially since radio was invented, show that our sun is a variable sun. Life of some kind has existed on this earth for a period of perhaps a billion years, for the earliest rocks—the Cambrian rocks—are fossiliferous, and the type of life represented is far from primitive. During all this long period which life has been on earth, the sun's magnitude must have remained within half a magnitude of its present value. If its magnitude were to fall one-half a magnitude and remain so for a

few years, all life would be frozen, and if it were to increase one magnitude and its brightness become 2½ times what it is now, the temperature of the earth would rise to boiling point, so that seas would soon boil away and all life would be annihilated.

How does all the tremendous heat and light of the sun come about? If the sun had been made of anthracite coal, it would have burned out in 5,000 years. Here we are faced with one of the great mysteries of astronomy. What has kept our particular star —the sun—at its present magnitude for millions of years? And how long will it remain so? We can picture the time which will surely come when our sun having dissipated all its light and heat, will still, in obedience to one of the Creator's great laws, keep moving through space, a dark sun, surrounded by eight planets and their satellites, on which life has long ceased to exist. Yes, as I said at the beginning, we are passengers on this planet earth, and how few there are who ever give a thought to what is our destination, and to the splendours of the heavens above us. "The heavens declare the glory of God and the firmament sheweth his handiwork."

These are some of the mysteries and wonders of the heavens of which we know so little. The last 25 years have extended their boundaries hundreds of thousands of light years, so rapidly is modern astronomy advancing.

We can realize something of the feelings of Jean Paul Richter when he cried: "I will go no further, for the spirit of man aches with this infinity. Insufferable is the glory of God, for ending is there none to the universe of God, and there is no beginning."

The powerful telescopes of our day push back the borderland of unplumbed space, and the mind is lost in such immensities, but our imagination is free to wonder what lies beyond.

Winnipeg, Man.

USES OF CALCULATING MACHINES IN ASTRONOMICAL COMPUTATION

By C. C. Smith

THE greater ease, speed and accuracy with which computations in a decimal system can be effected by machines soon impresses itself on any computer. The only limit to their use is the lack, either of a machine suited to the particular type of computation involved, or of the tables of the functions involved given in natural numbers rather than in logarithms.

The types of computing machines are rapidly being improved. Many are being made for special uses in accounting, many small and cheap, but efficient, desk machines are being evolved, those machines that lacked a subtraction device are adding it and all working towards the goal of making the machine as automatic as possible.

For astronomical computations a multiple-bank machine seems preferable to single-bank. Where the operations are entirely addition and subtraction and it is desirable to print the numbers as they are added, a Burroughs machine gives good service; where the operations involve addition, subtraction, multiplication and division (to which nearly all computations reduce) and a cheap and efficient desk machine is desired, a Munro has proved very satisfactory. For multiplication a Millionaire Multiplier is,—from the principle of its construction—the fastest machine. For purely automatic work, where the two numbers are put in, the machine started and allowed to carry out the calculation of multiplication or division, a Mercedes-Euclid has been giving very good service.

For other purposes, other machines would undoubtedly prove superior. A single-bank machine is more compact, a duplex machine is preferable in accounting and a combination typewriter

and calculator has been used here for a long time with good satisfaction.

In meridian observations of star transits, 20 records of clock time are made by the printing chronograph and 4 records of zenith distance are printed for each transit. In a full night's work 60 or 80 stars may be observed. In addition there are some 200 quantities observed for instrumental constants. The first operation in computing these requires the finding of some 200 sums each containing from 4 to 20 quantities. A Burroughs adding machine prints these quantities on the computation forms. To check these additions it is only necessary to compare the original quantities with those printed on the forms. With a clerk operating the machine, these quantities can be read out, put in, added and printed at an average rate of between two and three seconds apiece,—evidently as fast as they can be written down by hand. The observer who reads the quantities does so with much less chance of error and in the actual addition there is no chance of error, so while it may be advisable to check the agreement of the printed figures with the original observations no check of the additions is required, hence resulting in a saving of at least half of the observer's time and of much labour and the mistakes that formerly occurred. The reduction of the apparent place of a star to the mean place by the formula

$$x = Aa \pm Bb \pm Cc \pm Dd,$$

(or one of the other equivalent formulas) was done formerly by the use of logarithms and was a very slow and laborious operation. Most of the tables of star and day numbers involved are still given in logarithms. The process of reduction is very much improved, however, by obtaining the natural values for the variables involved and doing the multiplications on a machine. In a machine like the Mercedes-Euclid, the four multiplications can be performed in succession and the additions (or subtractions) carried through automatically, so that no result is written down until the final value "x" is obtained. In these automatic machines when the multiplier and multiplicand in multiplication, or the divisor and dividend in division, are set in two key-boards, the machine is started and left to complete the calculation. Multiplication of 9 figures by 8 figures

or division of 16 figures by 9 figures takes 10 seconds. To carry out the multiplications and additions (or subtractions) in the example given above for star reductions takes approximately one minute. This is at least three times as fast as it is done by logarithms and the chance of error is very small.

The use of logarithms has not been entirely superseded by machines working with natural numbers. Operations involving roots and powers of large numbers are more easily worked with logarithmic tables. But for almost all computations in star reductions, miscellaneous computations, least squares, simple equations, etc., the calculating machine is used nearly exclusively.

Under ordinary use the life of a machine is somewhere between 10 and 20 years. One machine was used almost continuously here for 17 years and was then replaced by a more modern type. For continuous work a motor driven machine, if given fair care, is easier to handle and lasts longer than a hand driven machine, but for desk work the latter seems preferable.

Dominion Observatory,
Ottawa, December, 1927.

THE PLANET NEPTUNE

A Concise Tabulation of Many Items of Interest to the Amateur.

By W. G. Colgrove

Name.—Neptune is Latin, probably from *napta,* meaning moist. The Greeks called him Poseidon and worshipped him in many cities and on many shores, especially at Corinth where the Isthmian Games were held in his honour. Arago thought the planet should be called after Leverrier but mythology again won the day and a name that had been proposed for Uranus was given to it. Neptune was located in 1846 by Galle of Berlin within a degree of the place indicated by Leverrier of Paris who had calculated its position. The calculation was based chiefly upon observations of the unusual perturbations of Uranus. Similar calculations had been made in England some months before, by Adams of Cambridge who assigned a similar position and informed the Astronomer Royal, but he failed to make the requested search.

Myth.—When Jupiter and his brothers, including Neptune, overthrew their parents the Titans, Neptune and his wife Amphitrite succeeded to the dominion of the waters in place of Oceanus and Tethys. He is said to have domesticated the horse and to have given his own steeds, the waves, golden manes and bronze hoofs with which, drawing his chariot, they galloped over the shimmering sea.

Symbol.—A trident fashioned like the three-pointed harpoon of the Ægean fisherman. With this strange instrument, at once a weapon and a wand, he is said to have shattered rocks and summoned or silenced the most terrific storms on land and sea.

Colour.—In a large telescope one sees the planet as a small indefinite disk glowing with a greenish blue tint similar to Uranus.

Markings.—Because of the great distance and the small angular

diameter, as well as the dense atmosphere, no permanent markings have been seen.

Stellar Magnitude.—7.6 at opposition. This is too small to be seen by the unaided eye, but with a good field glass it may be observed as a small star.

Angular Diameter.—Mean equatorial 2.5″. The variation of this measure is very slight on account of its great distance from the sun and the small eccentricity of its orbit.

Linear Diameter.—Mean equatorial 33,000 miles, about four times that of the earth. The circumference will be a little more than 100,000 miles.

Area of Surface.—About 3,422,570,000 square miles, about 1/700 of the sun or 16 times our earth. Like the other major planets, however, it is still in a semi-gaseous condition.

Volume.—18,816,000,000,000 cubic miles, about 72 times our planet or 1/20,000 of the sun.

Mass.—About 17 times the earth or 1/19,350 of the sun.

Density.—1.11 of water or .21 of the earth, very much like the other major planets.

Gravity.—.89 of our earth or about the same as Uranus.

Rotation Period.—Probably about 12 hours but this has not yet been settled because of the lack of permanent markings on its surface. On this account the number of days in the planet's year cannot be determined.

Distance from Sun.—Mean 2,792,700,000 miles, or slightly over thirty astronomical units; about eighty times as far as Mercury. From such a distance one could not see any of the inner planets, even Saturn would be reduced to the fifth magnitude and would separate out from the sun only 18°. The sun would be about 1′ in diameter, or a little brighter than Venus at her greatest brilliancy.

Distance from Earth.—At opposition it is about 2,700,000,000 miles while at conjunction it is about 2,886,000,000 miles away.

Revolution (Sidereal Period).—164.78 years or 60,186 earth days. That is about twice as long as Uranus and about fifteen times as long as Jupiter. Since its discovery it has covered about half its orbital course.

Revolution (Synodic Period).—Mean 367.5 days or 1 year, 2 days.

Orbital Velocity.—3.33 miles a second, 200 miles a minute, 12,460 miles an hour, 299,000 miles a day. Its mean daily motion is 22″ or about 2.2° a year. This is the slowest of all.

Arc of Retrograde.—About 3 degrees. This apparent reverse motion continues for about four months. It will seem to stand still on May 7 and Dec. 4 of this year.

Eccentricity of Orbit.—.0085 about 50,000,000 miles making a total difference of 100,000,000 miles between perihelion and aphelion distances. The orbit is almost a circle.

Solar Radiation.—On account of its great distance the quantity of light is reduced to about 1/900 of amount per unit area received by the earth. Neptune will therefore be an exceedingly cold planet.

Temperature.—In spite of the lack of solar heat Neptune's actual surface may be warmed from internal sources and this local supply will be conserved by the dense atmosphere.

Albedo.—.73. This would put it in the highest class along with Venus and Jupiter and indicate a heavily cloud-laden atmosphere.

Atmosphere.—The spectrum shows bands similar to the other major planets but stronger and indicates an even denser atmosphere. It would seem to be, in many ways, a twin to Uranus.

Inclination of Equator to Orbit.—151°. This is a very large angle and would suggest an apparent backward motion resulting in most unusual seasons. Such conditions can be only a matter of conjecture until further instrumental development.

Inclination of Orbit to Ecliptic.—1° 47′ a small angle.

Conjunction and Quadrature.—These are unimportant on account of the planet's great distance. The next conjunction will occur Aug. 22 and the next quadrature Nov. 23 of this year.

Oppositions.—The next will be on Feb. 17, of this year.

Satellite.—Neptune, like the earth, has but one moon thus far discovered and this was found by Lassell within a month after the discovery of the planet. Its orbit is almost circular with a radius of 220,000 miles and a period of 5 days, 21 hours, 2 minutes. The inclination of its orbit to that of its primary is between 35° and 40° and it revolves in a retrograde direction. Its magnitude is between 13 and 14 and in mass and diameter it is supposed to be almost a twin for our moon.

Lambeth, Ontario.

REVIEW OF PUBLICATIONS

Isostasy, by William Bowie, Chief of the Division of Geodesy in the U.S. Coast and Geodetic Survey. 275 pages, 5½ x 8 in., New York: E. P. Dutton & Co., 1927, Price $5.00.

Measurements of the shape and size of the earth have led to the view that there is a surface about 60 miles below sea level upon which the pressure exerted by the outer material of the earth is everywhere uniform. The word used to express this condition of equilibrium of the outer portion of the earth is *isostasy*.

The author of this book has had much to do in transforming this view from a speculative theory to an accepted scientific principle. Heretofore one had to search through technical publications to find anything authoritative on the subject, but this work unfolds the subject in a systematic and clear manner.

There are two views on isostasy. According to the first, which is associated with the name of Pratt, the earth's crust extends to a certain depth below sea level with varying densities of crustal material under elevations and depressions; the other, known as Airy's theory, teaches that the crustal matter has uniform density and varying thickness. The author's investigations substantiate the former.

Among those referred to as contributing to the theory of isostasy the names of A. H. Miller and the late O. Klotz of the Dominion Observatory, Ottawa, are given.

C. A. C.

"*The Space Distribution of the Stars of Different Types in the Cygnus Region of the Milky Way*. Maxwell, *Lick Observatory Bulletin* No. 390.

Bu using the absolute magnitudes of 2167 stars of types B to M, determined spectroscopically at Mount Wilson, Maxwell deduces mean values for each sub-class and obtains the well-known

Hertzsprung-Russell diagram connecting type and absolute brightness. Thus, by determining the spectral type of a star of unknown distance and adopting the mean value for the absolute magnitude for that particular type a simple computation gives the distance, provided the apparent magnitude of the star is known. These "spectral" parallaxes are individually not very accurate, owing to the spread in real luminosity within any one class, but for statistical investigations where large numbers of stars are employed they serve a useful purpose in arriving at mean distances.

This method was adopted by Maxwell to obtain the distances in the direction of the Milky Way in Cygnus. The Henry Draper Catalogue and Extension thereto gives him the magnitudes and spectral types of all stars as faint as the 10th magnitude. Moreover, the magnitudes on the photographic scale have, for certain selected areas within this region, been determined by Pickering and Kapteyn down to magnitude 16.5. Maxwell's particular contribution, from the observational standpoint, was the determination of the spectral types of the stars within these restricted areas from the 10th to the 14th magnitudes.

To this end he used a quartz slitless spectrograph as a prismatic camera in connection with the Crossley reflector. The dispersion is only 7.4 millimetres between $H\beta$ and $H\epsilon$ but 40 to 50 spectra are found on the plates in a field whose diameter is 22 minutes of arc. Each of the six selected areas was divided into four regions and the camera pointed at the centre of each region. Exposures of 5 hours each were given for the fainter stars and duplicate exposures of 1 hour each were made for the brighter stars.

On these plates between the magnitudes 10 and 14 there were found 557 stars whose spectral types he determined by comparing them with standards photographed with the same instrument. It was necessary, of course, to distinguish between the giant and dwarf branch in the later types and his main criterion for the distinction was the cyanogen band at 3883 which is strong in giant stars.

Adopting mean values of the absolute magnitude for each type he deduced the individual distances for each one of these 557 stars and was thus able to tabulate the number in any given volume of

space. One by-product is that the dwarfs of K-type are much more numerous in our vicinity than had been previously supposed.

Taking approximately larger areas of the sky for stars brighter than the 10th magnitude he counts their numbers in the Henry Draper Catalogue and Extension and deduces mean values of the distance for each apparent magnitude and type. He can thus plot curves for each type, one co-ordinate representing distance and the other the number at that distance. The curves, while not identical, have many points of resemblance, the numbers of stars falling off rapidly as the distance is increased beyond 300 or 400 parsecs.

Interesting conclusions are reached also as to the relative numbers of giants of the different types; his own result of the greater number of A's than K's being in conformity with Shapley's idea that A's predominate in the galactic regions. Then too the falling off in numbers with distance can be interpreted either on the idea of a local cluster in an extended universe or on the earlier idea of a universe restricted in size.

The whole investigation shows thoroughness and care, and yet, one feels with the author that too much weight should not be given some of the results by reason of the limited character of the observational data. W. E. H.

Annual Report of the Director, United States Coast and Geodetic Survey, for the fiscal year ended June 30, 1927.

This contains a summary of the work done in the 111th year of the existence of the Coast and Geodetic Survey. During the year there was an unprecendented demand for charts and other nautical publications sold at specified prices, the receipts being nearly $60,000. The Director urges an increase in the staff which, he declares, is inadequate to meet the normal demands upon the office.

The Survey carries on extensive operations on the land, but in recent years its outstanding work has been on the coastal waters. This has been rendered necessary through the development of new harbours and the increase in shipping. This important work is described briefly and is illustrated by a large number of charts.

An interesting story is told in connection with new instruments.

A nine-inch first-order theodolite was designed in 1925 to meet the demands for a more accurate, durable and speedy theodolite than was to be had through commercial channels. It is stated that it is now finished except for the circle which is being graduated abroad. The present writer was surprised that this was not being done at home. It certainly could be, if suitable facilities were provided, as the experience with a radio acoustic instrument surely shows. In this case bids were called for, but the only one received was so high and the time for delivery so long that the instrument division undertook the work itself. The apparatus was completed in six weeks and at a cost about 40 per cent. of the quoted price. The saving was $10,000.

The Report gives a full account of the work done in the various divisions, namely, instruments, geodesy, terrestrial magnetism and seismology, hydrography, tides and currents, and charts; and the Director in a straightforward fashion presents his requests for the means to improve the service. The Survey has had a long and creditable history and is doing excellent and indispensable work.

C. A. C.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

A Personal Note

The present writer was greatly pleased to learn that Mr. H. H. Plaskett, a former student and a friend, had been appointed lecturer on astrophysics in the Harvard College Observatory for one year from February 1. Hitherto the Observatory has limited itself to astronomical research and has taken little part in the training of graduate students in the University, but Mr. Plaskett's work will be to a considerable extent with such students. He will discuss especially the recent application of atomic physics to explain the nature of the interior of the stars and the structure of their atmospheres.

Mr. Plaskett received his B.A. degree from the University of Toronto in 1916. He then entered the army and his scientific training soon won him promotion in the artillery. After the war he studied six months under Professor Alfred Fowler, the distinguished spectroscopist at South Kensington. On his return to Canada he was appointed to the Dominion Astrophysical Observatory at Victoria, B.C. He has published some important papers which have obtained wide recognition.

Mr. Plaskett has been given a year's leave of absence by the Dominion Government, and with his wife and two children will live in Cambridge.

A New Fellowship At Harvard

A gift of $25,000 to the Harvard Observatory has been made by Mr. George R. Agassiz, chairman of the Observatory's Visiting Committee, in order to found a research fellowship. The holder of the fellowship is expected to carry on his investigations at the Observatory, preferably as a candidate for the Ph.D. degree at the University.

The first holder of this Agassiz Research Fellowship is Mr. Frank S. Hogg. Mr. Hogg's home is in Preston, Ont. He obtained the B.A. degree at the University of Toronto in 1925, being awarded the Royal Astronomical Society's Gold Medal. Since then he has been at the Harvard Observatory. The present writer wishes to congratulate Mr. Hogg on this recognition of his work.

The Aurora—Its Height and Audibility

The measurements of Störmer and his assistants have shown that the lower limit of the height of the aurorae observed by then, (usually, I believe, of the curtain variety) was about 87 km. This however, does not prove that auroral displays never occur at a smaller altitude, and observations by several persons are evidence that the seat of the phenomenon is sometimes much nearer the surface of the earth.

In the *Publications of the Astronomical Society of the Pacific* for December, 1927, James Halvor Johnson states that while living at Eagle, in Alaska, in longitude 141° 11′ W. and latitude 64° 47′ N., on a night when the temperature was 45° below zero Fahr., he witnessed an aurora which was clearly between himself and a steep bluff 1200 ft. high and half-a-mile away. The display, consisting of dancing streamers having prismatic colours, was about one-quarter way down from the summit of the bluff and no part reached the summit. It seemed nearer the bluff than to him and he was surprised at its apparent nearness.

He says: "There was a swishing sound at times as they [the streamers] moved. In fact, I think it was this sound that first directed my attention. Faint sounds oft accompany aurorae and are heard when not too distant."

Audibility of the Aurora

Mr. C. Carlyle Davidson, of Sorrento, B.C., writes as follows:—"I spent the winter of 1898 at Fort Graham, on the Finley River, B.C., and during the appearance of the aurora, which frequently occurred, I have distinctly heard a 'swishing' sound. The Indians there paid no attention to this sound, seemingly having heard it before.

At Fort Graham the source of the aurora appeared to be just behind the mountain not far distant, and not as a reflection appearing in the sky, as I see it now, at times, from where I live."

A Remarkable Meteorite

Mr. N. T. Bobrovnikoff in *Publications of the Astronomical Society of the Pacific* for December, 1927, gives some information regarding a meteorite which was seen at about 7 a.m., on June 30, 1908, in the province of Yenissei, Siberia. It proceeded from S.S.W. to N.N.E. and apparently fell in the region of the Vanovara which flows into the Podkamennoya Tunguska, a tributary of the Yenissei. The location is roughly long. 103° E. and lat. 60° N. The shock of the fall of the meteorite was registered by the seismographs at Irkutsk (800 miles distant) and Kirensk (300 miles). In the latter city the barographs registered the air-wave accompanying the meteor.

The fall was preceded by a bright light, a dark cloud and loud reverberations. It fell in an almost inaccessible place. An expedition under L. A. Kulik in 1921 could not locate the meteorite; but another expedition recently returned to Leningrad with the report that it had been found. It fell in many pieces, and it is stated that the ground for several square miles is pitted with funnels not unlike lunar formations. The total weight is given as half-a-million tons. These last two statements almost shake our faith in the rest of the story, and it is to be hoped that further and undoubted information may be obtained.

A Large Disk of Glass

The great disc for the 72-inch mirror of the Astrophysical Observatory at Victoria, B.C., was shipped from Belgium just a week before the great war began; and a few months later the glass works were destroyed. During the war the acute need for optical glass led to extensive experimenting and to successful production of this very necessary article in the United States. Besides the small pieces from which the optical portions of field glasses, range finders, etc., were made, some discs of considerable size, suitable for lenses and mirrors were also made. But with the close of the conflict the great urgency for self-preservation and also the spur of commercial

returns disappeared, and the efforts to produce glass for optical purposes in the United States were largely discontinued.

For several years there has been a demand for several large discs for reflecting telescopes which either have been constructed or are projected. The discs, however, have not been forthcoming. Orders for them can be placed in England and Germany, but the U.S. customs wall is high, adding materially to the price of such articles. Even with this tariff assistance, no private company seems willing to undertake the work.

It is interesting to learn that the Bureau of Standards at Washington has not given up their investigation into the manufacture of glass, and that it has at present a great disc which is in process of annealing. It was cast in an iron mould which at the same time is an electrically heated annealing furnace. The disc is of borosilicate crown glass. It is about 70 inches in diameter, 12½ inches thick and weighs 4,000 pounds. The mould weighs 5 tons and the insulation about 2 tons. The glass, as it approached the annealing temperature, was allowed to cool about 2°C. per day, and then it was kept at a constant temperature for six weeks. After that the slow reduction in temperature was started again. The whole process will take about 10 months, and as the disc was cast in May last it will not be ready for examination until February. It is to be hoped that the disc will be found to be of good quality and satisfactorily annealed so that it will not fracture when worked or expand irregularly with change of temperature.

It is reported that even though the disc is satisfactory the Bureau may have difficulty in disposing of it, that an act of Congress may be required to permit of it. If the actual cost of producing it is assessed against the institution which may ask for it the glass will be an expensive acquisition.

WHEN DID THE MOON RISE?

"It was a fine dry night, and the light of a young moon, which was then just rising, shed around that peace and tranquility which gives to evening time its most delicious charm."—*"Barnaby Rudge"*, by CHARLES DICKENS, Chapter 14.

C. A. C.

MEETINGS OF THE SOCIETY

AT TORONTO

The regular fortnightly meeting was held in the Physics Building of the University on Tuesday, Nov. 1st, 1927. Mr. A. F. Hunter in the chair.

The following were nominated for membership:—

Edwin B. McBryde, 54 Moore Avenue, Toronto

T. J. Ferris, 29 Charles St. W., Toronto

L. H. R. Wismer, 118 Moore Avenue, Toronto

Prof. C. C. Crump, Ph.D., Perkins Observatory, Delaware, Ohio.

Mr. Hunter reveiwed the events and conditions leading up to the action of the Council in asking for the establishing of a Toronto Centre. The President for the last year or two, has had the heavy burden of responsibility for obtaining speakers for the general meetings in Toronto, added to the task of occupying the chair.

Prof. Chant stated that some changes to the Constitution had been under discussion at the last Council Meeting, but it was agreed that no alteration should be made.

He explained the sources of revenue from which the Society received its funds. He also outlined the principal disbursements, which included the cost of printing the *Journal* and *Handbook*, the purchase of books for the library, and also its upkeep. He advocated strongly a change so that the burden now resting on the President be removed, and the smoother workings of the Society be facilitated. To this end Prof. Chant moved, seconded by Mr. P. M. Millman—

(1) That a committee (to be named) be appointed to select suitable names of officers to conduct the ordinary meetings of the Society of Toronto.

(2) That the officers comprise a president, vice-president, secretary-treasurer and at least three councillors; but the committee is empowered to make additions or alterations to this proposed list.

(3) That the committe report at the next ordinary meeting at Toronto.

Mr. A. F. Miller thanked Prof. Chant for his splendid statement of affairs, but still thought that any change was unnecessary. He was sorry that the president had been burdened.

Mr. A. R. Hassard, B.C.L., stated that he had examined carefully the

clauses in the constitution dealing with the matter, and gave it as his opinion that the Council's action was illegal, and discussion therefore not relevant.

Mr. J. R. Collins pointed out that the Council should have sent on the matter as a recommendation and he understood that to be the action of the Council. He suggested simply a committee to take care of the programme.

Prof. Chant, was quite willing to withdraw his motion if a programme committee were named. He could not agree, however, with Mr. Hassard's interpretation of the constitution.

It was finally agreed on motion of Mr. Hassard, seconded by Mr. Collins, that such a committee be appointed. The members nominated were Mr. Hassard, Mr. Hunter, and Mr. Collins, this committee to act until the end of the present session.

Mr. Hassard was then called upon by the President to address the meeting on the subject "Summer Observations".

He told of his observations of the moon's eclipse, which took place during the early hours of the morning of June 15. The beautiful phenomena well repaid the loss of sleep. He next touched upon the visit of Pons-Winnecke comet, viewing it on six successive days. He demonstrated the path through the constellations Cygnus and the Dolphin.

The planet Saturn was a beautiful object during the summer, the rings, he stated, were quite open.

He next touched on the ever-present discussion of the Chicago drainage canal, his observations showed that this year the lake levels were much higher than last; his contention that the Chicago diversion was not the full cause of the lowering of lake levels in recent years seemed to be justified. His address was much enjoyed, illuminated as it was by touches of his native Irish wit.

Prof. Chant showed a photograph of the corona of the sun in eclipse, taken by the Astronomer Royal in Yorkshire, England, last summer.

He also referred to the diversion of water through the Chicago drainage canal. He stated the canal actually lowered the levels of the lakes by 7 or 8 inches. This was a permanent change of level.

He next gave us his announced talk on "An Introduction to Astronomy" illustrated by a new set of slides. It was agreed that this is one of the best sets of the kind to be seen anywhere. The subject matter is splendid, and admirably suited for the purpose Prof. Chant had in mind, *viz*: in schools, and popular lectures to beginners in the science. Its general use will help to popularize the subject.

E. J. A. Kennedy,
Recorder.

The Royal Astronomical Society of Canada

OFFICERS FOR 1927

Honorary President—Hon. G. H. Ferguson, K.C., B.A., LL.D., Minister of Education for Ontario
President—A. F. Hunter, M.A., Toronto
First Vice-President—H. R. Kingston, M.A., Ph.D., London
Second Vice-President—R. K. Young, Ph.D.
General Secretary—Lachlan Gilchrist, M.A., Ph.D., Toronto
General Treasurer—H. W. Barker, Toronto
Recorder—E. J. A. Kennedy
Librarian—Prof. C. A. Chant
Curator—Robert S. Duncan
Council—Mgr. C. P. Choquette, M.A., Lic.Scs., Montreal; J. B. Fraser, M.D., Toronto; R. A. Gray, B.A., Toronto; A. R. Hassard, B.C.L., Toronto; J. H. Horning, M.A., Toronto; Dr. Ralph DeLury, Ottawa; Prof. John Mathieson, M.A., Kingston; Prof. A. S. Eve, F.R.S., Montreal; John Satterly, M.A., D.Sc., Toronto; Dr. D. M. Wunder, Toronto; and Past Presidents: John A. Paterson, M.A., K.C.; Sir Frederic Stupart, F.R.S.C.; A. T. DeLury, M.A.; Louis B. Stewart, D.T.S.; Allan F. Miller; J. S. Plaskett, B.A., D.Sc.; J. R. Collins; W. E. W. Jackson, M.A.; R. Meldrum Stewart, M.A.; and the Presiding Officer of each Centre as follows: H. M. Ami, D.Sc., Ottawa; Col. W. E. Lyman, Montreal; Mrs. E. L. Taylor, Winnipeg; Prof. P. H. Elliot, Victoria, B.C.; H. R. Kingston, M.A., Ph.D., London.

OTTAWA CENTRE

President—Dr. H. M. Ami
Vice-President—C. C. Smith, B.A., D.L.S.
Secretary—A. H. Hawkins, D.L.S., Dominion Observatory, Ottawa
Treasurer—J. F. Fredette, D.L.S.
Council—W. W. Nichol, M.A.; J. S. Lane, B.A.; Dr. T. L. Tanton; and Past Presidents: R. M. Stewart, M.A.; J. J. McArthur, D.L.S.; R. E. DeLury, M.A., Ph.D.; R. J. McDiarmid, M.Sc., Ph.D.; and C. R. Coutlee, C.E.

MONTREAL CENTRE

Honorary President—Mgr. C. P. Choquette, M.A., Lic.Scs.
President—Col. W. E. Lyman.
1st Vice-President—Rev. W. T. B. Crombie, M.A.
2nd Vice-President—H. E. S. Asbury
Treasurer—Prof. A. J. Kelly
Secretary—Miss A. Vibert Douglas, Ph.D., McGill University, Montreal
Council—Prof. A. S. Eve, Prof. A. H. S. Gillson, H. W. Jesmer, Justice E. E. Howard, Geo. Sample, Julien C. Smith

LONDON CENTRE

President—H. R. Kingston, M.A., Ph.D.
Vice-President—Mrs. W. E. Saunders
Secretary-Treasurer—E. T. White, B.A., D.Paed., 36 Marley Place, London, Ont.
Council—Rev. R. J. Bowen, F.R.G.S.; T. C. Benson; Mrs. J. C. Middleton; W. A. McKenzie; E. H. McKone, B.A., D.Paed.

WINNIPEG CENTRE

President—Mrs. E. L. Taylor
Vice-President—Prof. L. A. H. Warren
Treasurer—Mr. H. B. Allan
Secretary—Mrs. S. C. Norris, 569 Sherburn St.
Council—Rev. T. W. Morton, B.Sc.; J. H. Kolb, Cecil Roy, A. W. Meggett, C. F. Ellis (*Asst. Sec.*); D. P. R. Coats and D. Saunders

VICTORIA CENTRE

Honorary President—F. Napier Denison.
President—Prof. P. H. Elliot, M.Sc.
Vice-President—J. A. Pearce, M.A.
Secretary-Treasurer—R. G. Miller, 2050 Oak Bay Rd., Victoria, B.C.
Council—E. E. Blackwood, J. P. Hibben, H. H. Plaskett; Rev S. Goodfellow, and Past Presidents: W. S. Drewry, J. E. Umbach, W. E. Harper, M.A., J. Duff, M.A., and J. S. Plaskett, F.R.S.